

Prime Factors!

ALL numbers except for 1, can be written as a product (answer for multiplication) of two different factors...

Ex. $6 = 2 \times 3, 1 \times 6$

$24 = 1 \times 24, 2 \times 12, 3 \times 8, 4 \times 6$

Find all pairs of factors for 36

Answer: $1 \times 36, 2 \times 18, 3 \times 12, 4 \times 9$

What about instead of a pair of factors, you wanted to find a triple, or quadruple?
(P.S. Who WOULDN'T?)

Use one of the pairs you found already...I'll use 2×18 -You could choose any pair...

$$\begin{array}{c}
 \swarrow \downarrow \searrow \\
 2 \times 3 \times 6 = 36 \\
 \downarrow \downarrow \downarrow \downarrow \searrow \\
 2 \times 3 \times 2 \times 3 = 36 \\
 2^2 \times 3^2 = 36
 \end{array}$$

In fact, I could keep going
from there, because $6 = 2 \times 3$

I can't go any farther, because 2 and 3 are PRIME numbers.

They cannot be divided evenly by any numbers other than themselves or 1.

That means that $2 \times 3 \times 2 \times 3$ is the PRIME FACTORIZATION of 36. 2 and 3 are the prime factors of 36.

To clean it up, we write the numbers together - $2 \times 2 \times 3 \times 3$
 To clean it up even more, we write it as powers $2^2 \times 3^2$
 Therefore the prime factorization of 36 is $2^2 \times 3^2$

Another way to find the prime factors, is to continually divide by the LOWEST PRIME FACTOR that will go into a number. These are usually 2,3,5.

Find the Prime Factors of 60

These
are the
Prime Factors

Keep dividing by 2 until the quotient is an odd number

15 is odd. Try 3 since 2 will not work.

5 isn't divisible by 3, try 5.

Quotient is 1. We're done!

Therefore the prime factors of 60 are $2^2 \times 3 \times 5$

So why even do this, other than the obvious reason which is FUN!

Well, remember LCM (lowest common multiple) and Common Factors? Prime factors can make that easy

Use the prime factors to find the first 3 common factors, and 3 lowest common multiples.

$$36 = 2 \times 2 \times 3 \times 3$$

$$60 = 2 \times 2 \times 3 \times 5$$

First pair of common prime factors

$2 \times 2 \times 3$ is common. THIS MEANS that 2, and 3 are common factors, and so are 2×2 (4), 2×3 (6), and $2 \times 2 \times 3$ (12)

The LCM will be the COMMON FACTORS \times REMAINING FACTORS

second pair of common prime factors

$$2 \times 2 \times 3 \times 3 \times 5 = 180$$

The second lowest multiple is 2×180
the third is 3×180

Homework.

Textbook pg 17

1a-d, 2, 3, 4 a-b, 5 a-b, 6-8, 11 and 14

Sept 15th Homework

Write each product as a number in standard form:

$$\text{a) } 2^2 \times 3^2 = 2 \times 2 \times 3 \times 3 = 4 \times 9 = 36$$

$$\text{b) } 7^2 \times 2^3 = 7 \times 7 \times 2 \times 2 \times 2 = 392$$

$$\text{c) } 5^2 \times 3^3 = 5 \times 5 \times 3 \times 3 \times 3 = 675$$

or this way:

$$\text{d) } 2^2 \times 3^2 \times 5 = 4 \times 9 \times 5 = 180$$

List the prime factors of each number (when listing and not putting as a product, you do not need to list the same number more than once):

a) 21 b) 14 c) 100 d) 125
e) 19 f) 50 g) 77 h) 96

a) 3, 7

b) 2, 7

c) 2, 5

d) 5

e) 19

f) 2, 5

g) 7, 11

h) 2, 3

Write each number as a product of prime factors. Use exponents where possible.

- a) 48 b) 63 c) 400 d) 16
e) 120 f) 55 g) 36 h) 88

a) 48

$$\begin{array}{c}
 48 \\
 \swarrow \searrow \\
 2 \times 24 \\
 \swarrow \searrow \quad \swarrow \searrow \\
 2 \times 2 \times 12 \quad 2 \times 6 \\
 \swarrow \searrow \quad \swarrow \searrow \quad \swarrow \searrow \\
 2 \times 2 \times 2 \times 3 \quad 2 \times 3 \\
 2 \times 2 \times 2 \times 2 \times 3 \\
 48 = 2^4 \times 3
 \end{array}$$

b) 63

$$\begin{array}{c}
 63 \\
 \swarrow \searrow \\
 3 \times 21 \\
 \swarrow \searrow \quad \swarrow \searrow \\
 3 \times 3 \times 7 \\
 63 = 3^2 \times 7
 \end{array}$$

c) 400

$$\begin{array}{c}
 400 \\
 \swarrow \searrow \\
 2 \times 200 \\
 \swarrow \searrow \quad \swarrow \searrow \\
 2 \times 2 \times 100 \quad 2 \times 50 \\
 \swarrow \searrow \quad \swarrow \searrow \quad \swarrow \searrow \quad \swarrow \searrow \\
 2 \times 2 \times 2 \times 25 \quad 2 \times 2 \times 25 \\
 2 \times 2 \times 2 \times 2 \times 5 \times 5 \\
 400 = 2^4 \times 5^2
 \end{array}$$

Other answers

$$d) 2^4$$

$$e) 2^3 \times 3 \times 5$$

$$f) 5 \times 11$$

$$g) 2^2 \times 3^2$$

$$h) 2^3 \times 11$$

Use the prime factors from questions 2 and 3.

Find all the common factors of each pair of numbers

a) 55, 88

$$55 \\ \swarrow \searrow \\ 5 \times 11$$

$$88 \\ \swarrow \searrow \\ 2 \times 44 \\ \swarrow \searrow \\ 2 \times 2 \times 22 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 2 \times 11$$

b) 48, 120

$$48 \\ \swarrow \searrow \\ 2 \times 24 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 12 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 2 \times 6 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 2 \times 2 \times 3$$

$$120 \\ \swarrow \searrow \\ 2 \times 60 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 30 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 2 \times 15 \\ \swarrow \searrow \swarrow \searrow \\ 2 \times 2 \times 2 \times 3 \times 5$$

- ① $2 \times 2 = 4$ } doubles
- ② $2 \times 3 = 6$ }
- ③ $2 \times 2 \times 2 = 8$ } triples
- ④ $2 \times 2 \times 3 = 12$ }
- ⑤ $2 \times 2 \times 2 \times 3 = 24$

$$C.F. = 2, 3, 4, 6, 8, 12, 24$$

Use the prime factors from questions 2 and 3.
Find the first 3 common multiples of each pair of numbers

a) 16, 21

b) 36, 96

A number has 2,3, and 5 as factors.

- a) Which number is the least possible number with these factors?
- b) Find two more numbers with these factors.

According to a student, the least number that has 2,3,4, and 5 as factors can be found by multiplying $2 \times 3 \times 4 \times 5$.

Is this student correct? Explain.

Answer: No. When all of the factors are PRIME, then multiplying them together gives you the lowest number. In this case, the 4 is not prime. This will mess us up, because if we were to make 4 prime, it would be 2×2 . We would have factors of 2, 3, 2×2 , and 5. You can see that we no longer need the FIRST 2, because the factor of 2 is included in the 2×2 . Therefore, multiplying $2 \times 3 \times 4 \times 5$ will give is a number that is double the lowest number with 2,3,4, and 5 as factors. $2 \times 3 \times 4 \times 5 = 120$. $2 \times 2 \times 3 \times 5 = 60$. Both have 2,3,4, and 5 as factors.

Can you find the greatest number with 11, 23, and 37 as factors? Explain

A number has 21 and 77 as factors.
Which is the least possible number?

Which other numbers are factors of your number in a) Explain your reasoning.

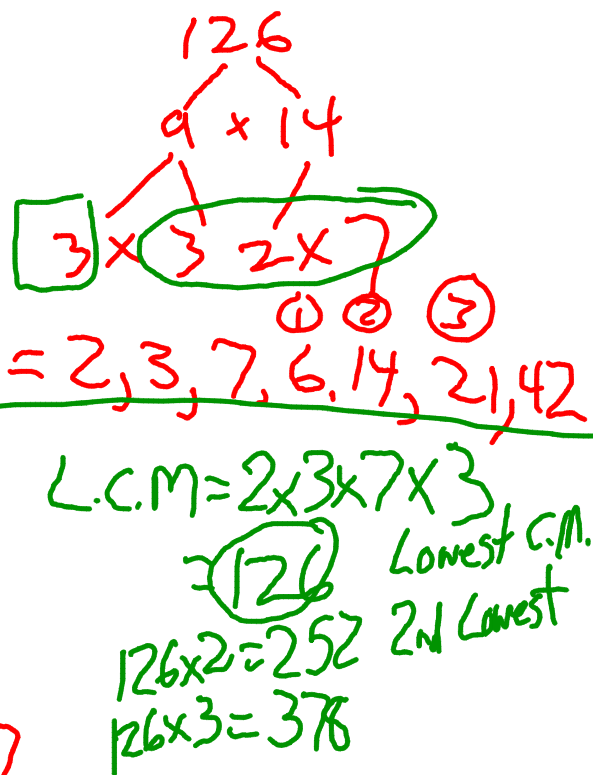
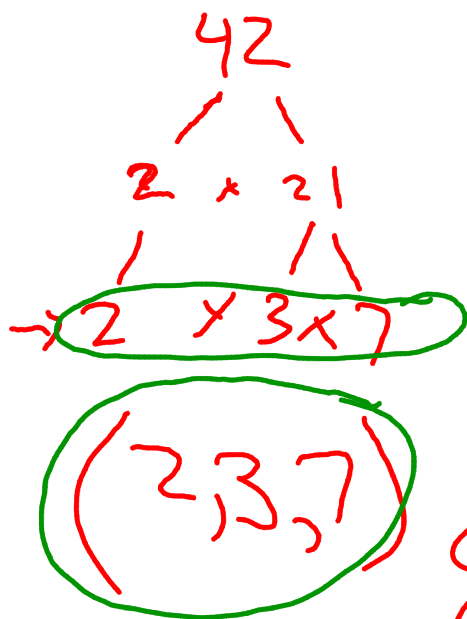
Is $4^2 \times 4^2$ a prime factorization of 256? Explain.

* List all common factors using prime factors.

a) 42, 126

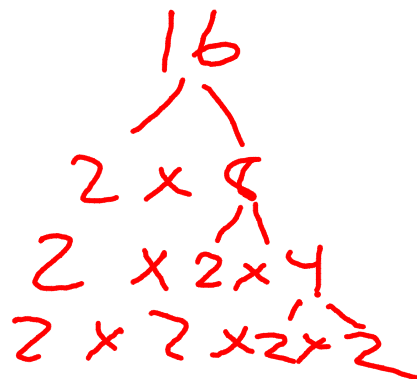
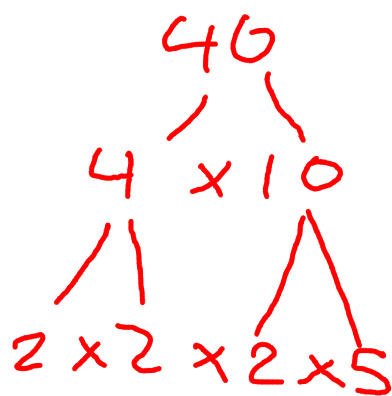
b) 40, 16

c) 49, 343



- ① 2×3
- ② 2×7
- ③ 3×7
- ④ $2 \times 3 \times 7$

C.F = $2, 3, 7, 6, 14, 21, 42$



$(2, 2, 2)$ C.F. = 2, 4, 8

- ① 2×2
- ② $2 \times 2 + 2$

$$\begin{array}{c} 49 \\ / \quad \backslash \\ 7 \times 7 \end{array}$$

$$C.F. = 7, 49$$

$$(7 \times 7)$$

$$\begin{array}{c} 343 \\ / \quad \backslash \\ 49 \times 7 \\ / \quad \backslash \\ 7 \times 7 \times 7 \end{array}$$